IN VITRO DIGESTIBILITY OF *KOCHIA PROSTRATA* (L.) SCHRAD.[1]

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ABSTRACT.— In vitro digestibility was determined for 13 accessions of *Kochia prostrata*. Vegetative samples were collected in February and April. No significant differences in digestibility were detected due to month sampled or among accessions. The mean in vitro digestibility of the 13 accessions was 32.2% of dry matter digested. The accessional range was from 20.2 to 38.0% of dry matter digested.

Kochia prostrata, commonly referred to as prostrate summer cypress, is being tested as a potential forage plant for western United States ranges. It was first introduced from Russia during the early 1960s (Keller and Bleak 1974). Limited nutritive studies have been conducted on accessions of *K. prostrata* (Davis 1979). Winter crude protein varied from 5.4 to 10.9% (Davis 1979, Davis and Welch 1984). Winter carotene content varied from 1.3 to 12.1 mg/100 g of dry matter (Davis 1979). Winter digestibility for *K. prostrata* has not been studied. Therefore, we undertook this study to determine the in vitro digestibility of accessions of *K. prostrata* grown on a uniform garden.

MATERIALS AND METHODS

Thirteen accessions of *K. prostrata* were selected to study in vitro digestibility from a uniform garden located at Ephraim, Utah. The source of the genetic materials for the accessions used in this study is given in Table 1. For each accession five plants were selected at random to furnish a composite vegetative sample needed for the digestion trials. The same plants were used throughout the study. Vegetative samples were collected in February and April 1982. During this part of the year, *K. prostrata* plants consist of two types of vegetative tissues, the "upper" and "lower" parts of the stem. The upper stem is that part of the stem where the seed was developed and has since shattered, leaving a dry, brownish, somewhat erect vegetative shoot. The lower stem is that part of the stem where green leaves begin. Both types of tissue were sampled from the selected plants. Samples were ovendried at 100 C for 48 hours. Then they were ground in a Wiley mill, passed through a 1-mm screen, and stored in airtight containers.

We used the in vitro digestibility procedure as outlined by Pearson (1970). Data were expressed as a percent of dry matter digested. A paired t-test was used to detect differences between upper and lower stem samples.

TABLE 1. Plant introduction numbers, U-numbers of the Utah Division of Wildlife Resources W-82-R, soil types, and location for *Kochia prostrata* accessions used in this study.

PI no.	U no.	Soil type	Location
330708	U-1	°	Tehran, Iran
314929	U-2	°	Stavropol, Russia
°	U-3	°	Yun Dudar, Russia
356824	U-5	Salty	Actobinsk, Russia
356823	U-6	Sandy	Actobinsk, Russia
356822	U-7	Clay	Ural Mountains, Russia
356821	U-8	Salty	Actobinsk, Aral Sea, Russia
356825	U-9	Clay	Actobinsk, Russia
356826	U-10	Salty	Actobinsk, Ural Mountains, Russia
356819	U-11	Salty	Actobinsk, Aral Sea, Russia
356820	U-12	Sandy	Actobinsk, Aral Sea, Russia
356818	U-13	Clay	Actobinsk, Aral Sea, Russia
356817	U-14	Salty	Actobinsk, Aral Sea, Russia

°Information not available

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TABLE 2. In vitro digestibility of the lower vegetative stem samples of *Kochia prostrata* for the months of February and April. Data are pooled for the two months and expressed as a percent of dry matter digested.

Accession no.	% dry matter digested	Accession no.	% dry matter digested
11	28.1	2	32.2
12	28.6	10	33.6
6	28.6	9	33.9
7	29.8	1	36.2
13	30.3	3	36.4
8	31.4	5	38.0

TABLE 3. In vitro digestibility of the upper vegetative stem samples of *Kochia prostrata* for the months of February and April. Data are pooled for the two months and expressed as a percent of dry matter digested.

Accession no.	% dry matter digested	Accession no.	% dry matter digested
11	20.2	12	26.4
6	21.5	8	27.7
7	21.6	1	28.6
9	22.8	2	29.7
10	23.0	5	33.0
13	26.0	3	35.8
14	26.2		

TABLE 4. In vitro digestibility of winter range forages.

Winter forage	Dry matter digestibility (%)	Reference*
Aspen	57.4	1
Big sagebrush	57.3	2,3,4,5,6,7,10
Bud sagebrush	57.0	8
Wood rose	54.5	1
Sand dropseed grass	53.2	8
Black sagebrush	53.1	8
Rose hips	51.1	6,7
Indian rice grass	50.0	8,10
Bluestem wheatgrass	49.6	10
Curl-leaf mahogany	49.1	4,6
Galleta	48.2	8
Needle-and-thread	47.0	10
Bluebunch wheatgrass	45.5	10
Common winterfat	44.7	8
Rubber rabbitbrush	44.4	10
Shadscale	43.4	8
Western snowberry	41.0	1
Chokecherry	38.8	1,11
Fourwing saltbush	38.3	9
Cliffrose	37.6	12
Desert bitterbrush	35.8	12
Prostrate summer cypress	32.2	this study
Apache-plume	29.8	12
Gambel oak	28.1	2
Antelope bitterbrush	25.6	4,6,12
True mahogany	24.4	4,6,10

*1. Dietz 1972.
2. Kufeld et al. 1981.
3. Sheehy 1975.
4. Urness et al. 1977.
5. Wallmo et al. 1977
6. Welch and Pederson 1981.
7. Pederson and Welch 1982.
8. Welch et al. 1983a.
9. Welch and Monsen 1984.
10. Ward 1971.
11. Uresk et al. 1975.
12. Welch et al. 1983b.

RESULTS AND DISCUSSION

No significant differences were detected between months (February and April), or among vegetative stem samples for (upper and lower) accessions. A t-test did show a significant difference between upper and lower vegetative stem samples. The lower samples' in vitro digestibility on an accessional basis ranged from 28.1 to 38.0% of dry matter, with a mean of 32.2 percent (Table 2). In vitro digestibility on an accessional basis for upper vegetative samples ranged from 20.2 to 35.8%, with a mean of 26.3% of the dry matter (Table 3).

As a winter forage, *Kochia prostrata* is low in digestibility (Table 4). It ranks 24th in the winter forages listed in Table 4. Winter crude protein content has been reported to be 8.5% (Davis 1979). Thus, *Kochia prostrata* could be used to increase winter supplies of crude protein while increasing diversity of forage.

LITERATURE CITED

DAVIS, A. M. 1979. Forage quality of prostrate *Kochia* compared with three browse species. Agron. J. 71:822–824.

DAVIS, J. N., AND B. L. WELCH. In press. Seasonal variation in crude protein among accessions of *Kochia prostrata*. *In* Proceedings of the *Atriplex* symposium. USDA, For. Serv. Gen. Tech. Rep. INT-____. Intermtn. For. and Range Exp. Sta., Ogden, Utah.

DIETZ, D. R. 1972. Nutritive value of shrubs. Pages 289–302 *in* Wildland shrubs—their biology and utilization: a symposium. USDA, For. Serv. Gen. Tech. Rep. INT-1. Intermtn. For. and Range Exp. Sta., Ogden, Utah. 494 pp.

KELLER, W., AND A. T. BLEAK. 1974. *Kochia prostrata*: a shrub for western ranges? Utah Sci. 34:24–25.

KUFELD, R. C., M. STEVENS, AND D. C. BOWDEN. 1981. Winter variation in nutrient and fiber content

and in vitro digestibility of gambel oak [*Quercus gambelli*] and big sagebrush [*Artemisia tridentata*] from diversified sites in Colorado. J. Range Manage. 34:149–151.

PEARSON, H. A. 1970. Digestibility trials: in vitro techniques. Pages 85–92 *in* Range and wildlife habitat evaluation—a research symposium. USDA, For. Serv. Misc. Pub. No. 1147. 220 pp.

PEDERSON, J. C., AND B. L. WELCH. 1982. Effects of monoterpenoid exposure on ability of rumen inocula to digest a set of forages. J. Range Manage. 35:500–502.

SHEEHY, D. P. 1975. Relative palatability of seven *Artemisia* taxa to mule deer and sheep. Unpublished thesis. Oregon State Univ., Corvallis. 147 pp.

URESK, D. W., D. R. DIETZ, AND H. E. MESSNER. 1975. Constituents of in vitro solution contribute differently to dry matter digestibility of deer food species. J. Range Manage. 28:419–421.

URNESS, P. J., A. D. SMITH, AND R. K. WATKINS. 1977. Comparison of in vivo and in vitro dry matter digestibility of mule deer forages. J. Range Manage. 30:119–121.

WALLMO, O. C., L. H. CARPENTER, W. L. REGELIN, R. B. GILL, AND D. L. BAKER. 1977. Evaluation of deer habitat on a nutritional basis. J. Range Manage. 30:122–127.

WARD, L. A. 1971. In vitro digestibility of elk winter forage in southern Wyoming. J. Wildl. Manage. 35:681–688.

WELCH, B. L., AND J. C. PEDERSON. 1981. In vitro digestibility among accessions of big sagebrush by wild mule deer and its relationship to monoterpenoid content. J. Range Manage. 34:497–500.

WELCH, B. L., J. C. PEDERSON, AND W. P. CLARY. 1983a. Ability of different rumen inoculum to digest range forages. J. Wildl. Manage. 47:873–877.

WELCH, B. L., S. B. MONSEN, AND N. L. SHAW. 1983b. Nutritive value of antelope and desert bitterbrush, stansbury cliffrose, and apache-plume. Pages 173–185 *in* Proceedings of the Bitterbrush and Cliffrose Symposium. USDA, For. Serv. Gen. Tech. Rep. INT-152. Intermtn. For. and Range Exp. Sta., Ogden, Utah.

WELCH, B. L., AND S. B. MONSEN. In press. Nutritive value of 43 accessions of fourwing saltbush (*Atriplex canescens*) grown on a uniform garden. *In* Proceedings of the *Atriplex* Symposium. USDA, For. Serv. Gen. Tech. Rep. INT-____. Intermtn. For. and Range Exp. Sta., Ogden, Utah.